

BACKGROUND:

RESEARCH BEING DONE AT THE HONEY BEE LAB



- House live bees in hoarding cages and lab incubators to examine the effects of varying levels of pesticide exposure and overall bee longevity and physiology.
- Propagate gut parasites for inoculant creation

PREVIOUS CAGE & PROTOTYPE: ORIGINAL DESIGNS AND ISSUES



- Difficult to separate live from dead bees.
- Cages aren't durable/easy to carry/safe to handle.
- Current cages have critical design flaws that allow bees to escape while testing and recording data.
- Syrup feeders leak and time to perform tasks is inefficient.

REQUIREMENTS/SPECIFICATIONS:

ENGINEERING REQS	TARGET SPECS
Well ventilated	Min. Airflow: 6.75E-7[m^3/s]
Lightweight	Weight: 3-4 lbs ± 1lb
Durable(chemical, crack, and chip resistant)	Drop Height: 5ft ± 1ft
Transparent	Transparency: 60% ± 10%
80 cages fit in incubator	Cage Size < 30"x25"x50"
Prevents bees escaping	Holes/Slits Under 3/16"
Syrup loss is negligible	Volume loss: 0-5% ± 5%



HONEY BEE HOARDING CAGE

Department of Horticulture: Honey Bee Lab

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Advisors: Dr. Sarah Oman, Dr. Brian Bay, Ali Alabdulali

MIME Team 109 Members:

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FINAL DESIGN AND PROJECT STATUS:

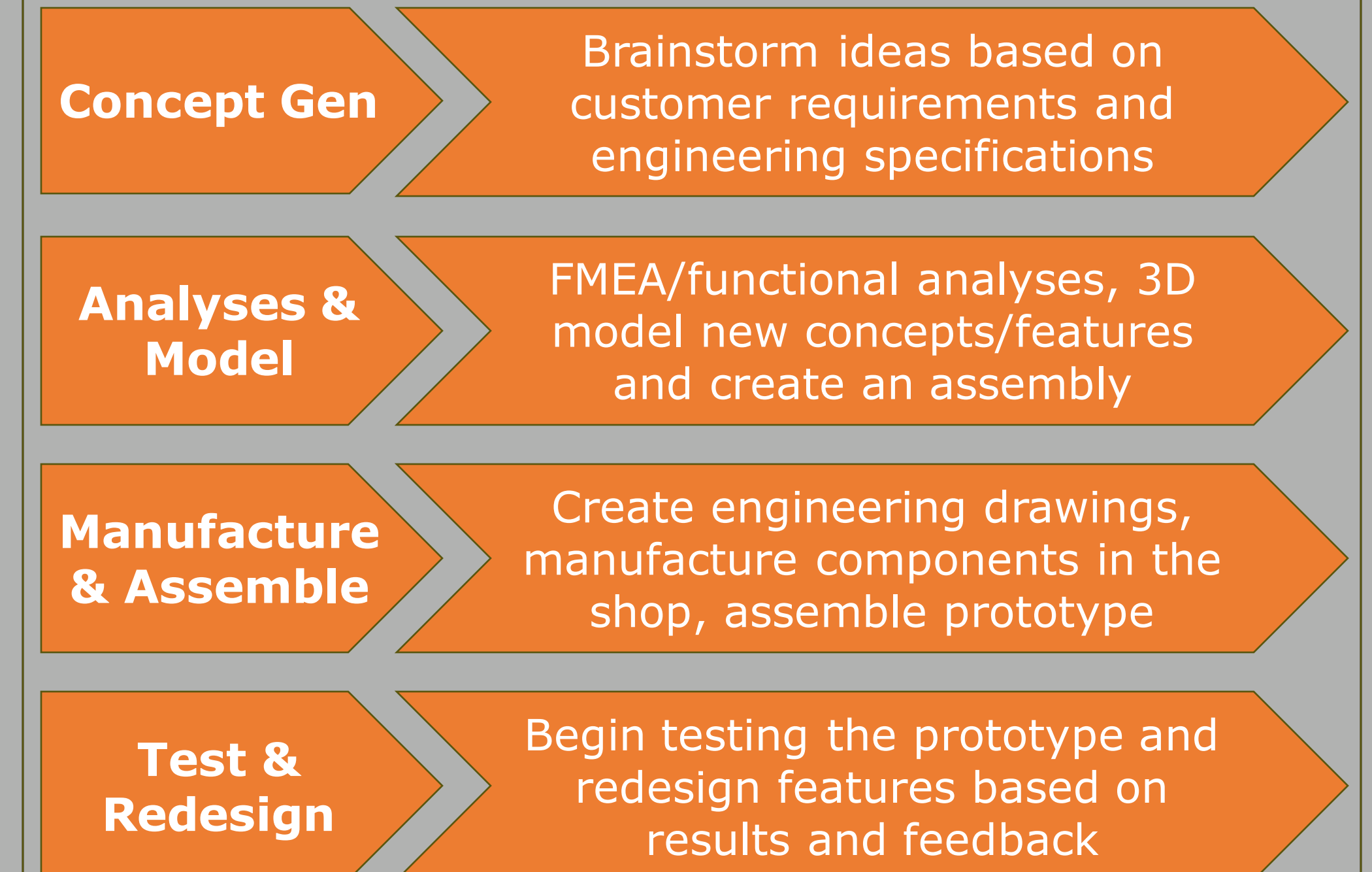
MODULAR CAGE	PURPOSE:	SINGLE CAGE IN USE
	Design and improve the previous capstone's prototype to finalize modular hoarding cages that are affordable, safe to handle, easy to use, and provide solutions to efficiently record data and conduct experiments.	
<p>PROJECT STATUS:</p> <p>The final prototype and design changes have been implemented and tested, passing both the customer requirements and engineering specifications. The finalized CAD package, manufacturing plan, drawings, and other deliverables are provided to facilitate the process in manufacturing 80 cages.</p>		

MAJOR DESIGN FEATURES/CHANGES:

<p>REMOVABLE POLLEN DRAWER</p>	<ul style="list-style-type: none"> • Able to be secured and removed through a detachable insert that connects using a tooth mechanism. • Allows pollen tray to be easily used and cleaned. • Elevated to increase the clearance provided for bees to leave the disposal tray, mitigating any injury risks.
<p>FEEDER VIAL ADAPTERS/TOPS</p>	<ul style="list-style-type: none"> • Allows vials to be secured on adapter and easily removed. • Designed for 25mL and 150mL vials. • Slit opening allows bees to feed and prevents escape. • Tops replace adapters on cage when not in use.
<p>SLIDE OUT DIVIDER/DISPOSAL TRAY</p>	<ul style="list-style-type: none"> • Allows dead bees to be collected by sliding out divider, causing bees to fall into the disposal tray • Divider prevents bees access to the disposal tray, allowing data to be easily recorded
<p>LATCHING MECHANISM</p>	<ul style="list-style-type: none"> • Acrylic latch secures the divider and disposal tray. • Can be removed to allow access to pheromone strips.
<p>LEAK-PROOF MESH CAPS</p>	<ul style="list-style-type: none"> • 40 mesh stainless steel screen combined with drilled cap holes allows honeybees to consume their water/syrup solution with negligible crystallization and leakage.
<p>SLIT ACRYLIC HOUSING</p>	<ul style="list-style-type: none"> • Acrylic housing secured with acrylic cement adhesive, producing a cleaner design. • Slit and openings allow sufficient airflow while keeping bees inside. • Slits create a climbable perching area.
<p>CONNECTION ADAPTER</p>	<ul style="list-style-type: none"> • Allows cages to be modular. • Adapter connects and secures two cages together.

TESTING/ANALYSIS

ITERATIVE DESIGN PROCESS

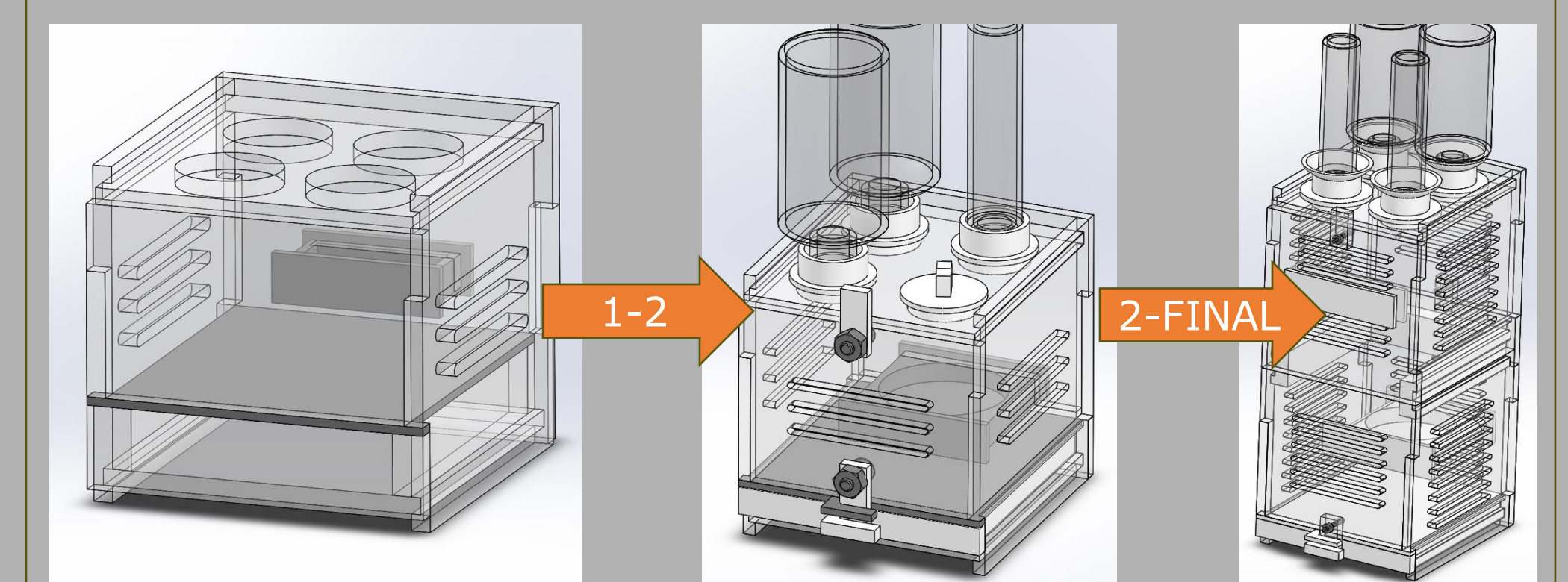


TESTING PROCEDURES/IMPROVEMENTS

1. **Airflow Test** – Analyzed in SolidWorks Flow Simulation. Calculates airflow required per cage.
2. **Weight Test** – Recorded with and without full feeder bottles after use to ensure the maximum possible weight during testing.
3. **Drop Test** – Administered from target height and repeated three times. Cage is inspected for signs of chipping, cracking, wear, etc.
4. **Cage Test** – Monitored by the HBL and sponsor for 1-2 weeks. Subtests include time measurements to remove dead bees and replace all four vials, maximum number of bees feeding per vial, time to replace all four vials, total bees escaped, and the total holdable surface area. Researchers provide feedback and recommendations during this test.
5. **Syrup Test** – % Volume lost from 25mL and 150mL vials are recorded over two days. OSUHBL testing and incubator conditions are simulated.

PROTOTYPE ITERATIONS

3D MODELED PROTOTYPES



MANUFACTURED PROTOTYPES

